into two types; that formed in the zone of flowage at right angles to the stress, and due to the growth of new particles and the orientation of old ones in this direction, thus giving rise to a grain in the rock, receives the name of *cleavage* proper; that which is due to definite planes of parting, formed along surfaces of shear, and originating in the zone of fracture, is called *fissility*. Those rocks, which on coming to the surface from the lower zone pass through the upper while under sufficient pressure to produce fissility, have this structure produced in the planes of true cleavage, while in other rocks it arises independently of any other structures. In deep-lying rocks fissility parallel to the bedding may be produced when the vertical weight is sufficient. Cracking and deposit of minerals may cause banded structures in imitation of bedding, and the imitation may be strengthened by further movement in the banded rock and by metamorphism.

The origin of joints and faults is somewhat lightly discussed. It is shown that both structures may result from pressure or tension, and Daubrée's explanation of joints by torsion is shown to be but another statement of their origin by complex folding. A very important point is made in linking these structures together and showing their relation to fissility, and it is insisted that "there is every gradation between faulting and fissility, and probably every gradation between faulting and cleavage."

Autoclastic rocks, crush-conglomerates and breccias, are next discussed, and it is pointed out how essential it is to discriminate between them and basement conglomerates. Metamorphism, in a wide sense, is next dealt with under the heads of consolidation, welding, cementation, injection, metasomatism, and mashing (dynamic metamorphism). The origin of the chief metamorphic rocks, both sedimentary and igneous, is fully discussed. In dealing with the most ancient sedimentary rocks, unconformities are of the greatest value, in spite of the undeniable difficulty of finding them; other tests of age are dates of intrusion and of movement, and number of movements undergone by different members of a succession. It must here be noted, however, that as the brain of a crow is unable to count more than three men with guns, so the brain of the geologist is inadequate to count more than three directions of movement, if so many. In igneous rocks the order of injection is still to be regarded as the great clue.

The pre-Cambrian rocks are divided into two great groups—the basement complex, or Archæan group, and the pre-Cambrian sediments, or Algonkian group. The different views held as to the origin of the first group are fully and fairly discussed, and after rejection of the theories that they are altered sediments, intrusive rocks, and primitive earth-crust, the view is provisionally adopted that, while little is probably left of the primitive earth-crust on which the Algonkian rocks were formed, it having been destroyed by erosion, the Archæan rocks represent the plutonic rocks solidifying beneath it, their formation in the upper part beginning in Archæan times and continuing steadfastly downwards to the present day. All the intrusions of those later-formed rocks, which have made their way to the surface through the upper (Archæan) layer, must be separated from it and considered as of later date. In dealing with the Algonkian rocks, a useful reference is given to all the fossils hitherto found in these rocks below the *Olenellus* zone, which is taken as the base of the Cambrian. The later part of Mr. Van Hise's paper will be found to be a most useful summary of the present state of knowledge of the American pre-Cambrian rocks.

The appendix to this paper contains a mathematical discussion of the depth of the zone of flowage, and the function of stress and strain on the rocks in producing cleavage and fissility.

NOTES.

THE following despatch from the Government of India to Lord George Hamilton is published in the latest number of the *Kew Bulletin*:—"We are informed by our Director of the Botanical Survey of India that the 'Flora of British India," which was begun by Sir Joseph Hooker some twenty-five years ago, has just been brought by him to completion. The value of the work as a contribution to pure science has already been appreciated and acknowledged by others who are more competent to speak in such a matter than ourselves. But we desire to express our hearty recognition of the service to India which Sir Joseph Hooker has rendered by his monumental undertaking. He has for the first time brought the botany of the Empire into a collective form and placed it upon a firm and lasting basis, thus completing the work which he began nearly half a century ago in the Himalayas. We would ask your lordship to convey to Sir Joseph Hooker our high appreciation of his labours, and of their value and importance as systematising and adding to our knowledge of the vegetable productions of India, and our hearty congratulations upon having brought to a satisfactory conclusion a work to which he has devoted so many years of his life." In transmitting a copy of this letter to Sir Joseph Hooker, Sir Arthur Godley writes:—"Lord George Hamilton desires heartily to associate himself with the Government of India in their acknowledgment of the valuable services you have done to India by this great work, and by your labour in the field of Indian botany, since you first visited that country nearly fifty years ago."

WITH reference to the foregoing note, we learn from the *Kew Bulletin* that Sir J. D. Hooker's literary activity has not ceased with the completion of the "Flora of British India," which has occupied him for a quarter of a century. The veteran botanist has offered to undertake the preparation of the two remaining volumes of the "Handbook to the Flora of Ceylon," left unwritten by the untimely death of Dr. Trimen. The necessary materials and specimens have already been received at Kew from the Royal Botanic Garden, Peradeniya.

THE St. John's correspondent of the *Times* states that Lieut. Peary, the Arctic explorer, has returned from Greenland, bringing the Cape York meteorite, weighing forty-five tons, the largest in the world, and also six Arctic Eskimos, who are going polewards with him next summer. All the members of the expedition are well.

THE Commission du Musée d'Histoire naturelle at Geneva has formed itself into a committee having for its object the erection of a monument to the memory of François Jules Pictet-de la Rive. A site for the monument has been granted in front of the museum. Old students of the eminent investigator, and all who are interested in the work which he accomplished, are invited to send subscriptions for the memorial fund to MM. Lombard, Odier & C^{ie}, Genève.

DR. T. W. ENGELMANN, professor of physiology in the University of Utrecht, has been appointed successor to the late Prof. Du Bois-Reymond in the chair of Physiology at Berlin.

PROF. WIESNER, of Vienna, has undertaken during the past summer a journey to Spitsbergen to complete his observations, previously made in the Tropics, as to the effect of light and other external conditions on the growth of plants.

AN International Ornithological Congress will be opened at Aix on November 9.

IT is reported that earthquake shocks were felt at Tashkent on Saturday last, September 18. The disturbance was noticeable over the whole of Turkestan, including Kasalinsk, Petrovsk, and Alexandrovsk. At Tashkent, Samarkand, and Ura-tiube several monuments of antiquity were damaged. A shock of earthquake, accompanied by a rumbling sound and the falling of rocks from the mountains, is also reported from the cantons of Grisons and Glarus, Switzerland.—A very severe shock of earthquake was experienced at Lima, Peru, on Monday, September 20. The cornices of churches and houses fell, and the walls were cracked.—At two o'clock on Tuesday afternoon, September 21, two shocks of earthquake were felt at Rome and in other places in Italy, including Rimini, Fermo, Recanati, Bologna, Sinigaglia, Fabriano, Cagli, and Florence. The shocks were also felt at Venice and Trieste.

FROM an obituary notice in the *British Medical Journal* (September 18) we derive the following particulars of the scientific career of the late Dr. A. F. Holmgren, whose death we have already announced:—Holmgren was born at Asen, in Linköpings Stift, on October 22, 1831, so that at his death he was almost sixty-six years of age. He studied at Upsala, and then became a teacher of natural science in a school. He graduated as M.D. in Upsala in 1861, and in the following year was commissioned to spend some years abroad to study physiology as it was taught by the great European masters. He studied under Ludwig at Vienna, and under Brücke, du Bois Reymond, and Helmholtz; while he also visited the schools of Paris, London, and Italy. In 1864 he was elected professor of physiology in Upsala, and built there the first physiological institute in Sweden. His scientific work ranges over a wide field, including his researches on the Negative Variation of the Muscle Current (1862), a similar condition in the active heart (1864); the action of poisons, calabar bean, chloroform, and atropine; the use of the ophthalmometer, and studies in colour sensation. Perhaps his best-known works are those on Retinal Currents. He showed the electrical currents of the retina, and how they are influenced by light, not only white light, but also the action of the various parts of the spectrum. He also showed that the electrical variation caused by light depends upon the retina only, and is not due to changes in the pigment, nor to the action of light on other constituents of the eyeball. His attention was in the early seventies directed to colour blindness, and in 1878 he published his well-known work on "Colour Blindness in relation to Railways and the Navy," thus bringing to a practical issue the work long before begun by George Wilson of Edinburgh (1855). This led him to the invention of his now well-known "worsted test" for colour vision. In 1889 he founded and became the editor of the *Skandanavisches Archiv für Physiologie*, as he says in the preface, "not only to unite our scattered forces under one flag," but to gain a powerful impulse for the advancement of the science in the north of Europe. He elected to publish all papers in German rather than Swedish for obvious reasons. To the last, optical studies were his favourite pursuit, and in 1891–92 we have a long paper in his *Archiv* "On Elementary Colour Sensation." All who were present at the Liège and Berne meetings of the Physiological Congress will remember Holmgren's genial presence, his stately eloquence, and his *bonhomie*. By universal consent he was perennial President of the Congress, and few who saw him two years ago would have thought that he would be so soon removed from his sphere of activity.

THE expectations of the inventor of the *Bazin* roller-boat as to the high rate of speed to be obtained with steamers without increase of engine power, owing to the diminution in frictional resistance of the wheels or rollers on which it was proposed to support the vessels, have not been realised. Accounts of this boat appeared in NATURE some months ago (vol. lv. pp. 109, 379). Since then the machinery has been completed and trials made on the Seine, which have shown that the action of the rollers does not decrease the frictional resistance of the water in the manner anticipated by the inventor, the adherence of the water to the surface of the wheels as they revolve acting as a brake and checking the forward movement of the vessel.

A NEW process for producing artificial diamonds has been experimented on successfully by Dr. Quirino Majorana (*Rendiconti della R. Accademia dei Lincei*). The present method consists fundamentally in heating a piece of carbon by the electric arc, and then submitting it to a violent pressure by means of a small plunger actuated by a piston, on which a pressure of 5000 atmospheres was suddenly developed by explosion. When a sufficiently strong cylinder had been constructed to withstand this enormous pressure, the experiment produced a black mass consisting largely of graphite and amorphous carbon. On employing Berthelot's method to isolate the diamonds if they existed, small microscopic crystals were obtained, mostly black and opaque, but which exhibited all the properties of true diamonds, notably in their manner of burning at a high temperature. The conclusion drawn from these experiments is that pressure and heat are alone sufficient to transform amorphous carbon into the crystalline or diamond form, and that the presence of a metallic solvent, as in Moissan's experiments, is not essential to the transformation.

AN optical device for the intensification of photographic pictures is described by Lord Rayleigh in the *Philosophical Magazine* for September. Photographers often obtain negatives which are so thin that intensification by chemical processes is insufficient to bring out any effective contrast between the transparent and opaque parts. The method devised by Lord Rayleigh is purely a physical one, and it may be described as a means of using a weak negative twice over. It is well known that by placing a feeble transparency upon a sheet of white paper, the picture becomes clearly visible, even though nothing can be seen when the transparency is viewed by holding it up to the light. Through the transparent parts the paper is seen with but little loss of brilliancy, while the opaque parts act, as it were, twice over, once before the light reaches the paper, and once again after reflection on its way to the eye. This is the principle of Lord Rayleigh's method. Instead of the paper, a flat polished reflector is used, the film side of the negative being placed in close contact with it. On the other side of the negative, and fairly close to it, is a condensing lens, which gives parallelism to the rays from the candle used as a source of illumination. The candle is placed just alongside of the copying lens; the light from it passes through the condensing lens, and falls as a parallel beam upon the negative. After reflection, the light again traverses the lens, and forms an image of the candle centred upon the photographic copying lens. An optically intensified positive is thus obtained, and by copying it in the same way in the camera, a negative with more pronounced contrast than the original may be made. To obtain satisfactory results, the false light reflected by the optical surfaces employed must be eliminated. In the case of the condensing lens the difficulty is overcome by giving the lens a slight slope with reference to the face of the negative. The false light reflected from the glass face of the negative to be copied may be got rid of by fixing a wedge-shaped glass plate to the glass side of the negative by means of fluid turpentine.

A DESCRIPTIVE list of mammals obtained from Somaliland by the East African Expedition of the Field Columbian Museum has been prepared by Mr. D. G. Elliot, and is now published in the Zoological Series of the Museum's publications. The expedition was sent to Africa to procure for the Museum specimens of the large wild animals which are rapidly becoming extinct. It appears to have been "uncommonly successful in obtaining ample series of nearly all the species inhabiting the country it traversed." Grace for the sin of killing animals which ought to be preserved may, perhaps, be found in the remark that "many more examples of the different species could easily have been procured, but after what was considered to be a sufficient number had been secured no more were killed, no matter how often the animals were encountered." The notes upon the characteristics and habits of the animals in life are very interesting.

IN previous numbers we have reproduced records of the Calcutta earthquake-pulsations of last June, obtained by means of the bifilar pendulum at Edinburgh and Cancani's seismometrograph at Rocca di Papa near Rome. Another fine diagram, made by the Vicentini microseismograph at Padua, is given in a paper by Dr. M. Baratta in the *Bollettino* of the Italian Geographical Society. The movement in both components began at 11.17 a.m. (Greenwich mean time), the pendular oscillations soon becoming very great. These lasted until about 11.35, but they were evidently superposed on long slow undulations, for the traces made by the pens are not symmetrical with respect to their normal positions. After 11.40 these undulations, which had a period of about twenty seconds, were isolated, and are unusually well marked, especially between 11.45 and 11.50. They are clearly visible on the diagram until 1·30 p.m., and, with the aid of a lens, for some time afterwards; so that, in consequence of this shock, the ground in Italy must have oscillated for about four hours.

THE kiss in Europe and China is the subject of a short paper by M. Paul d'Enjoy (*Bull. Soc. d'Anthrop.*, 1897, viii. p. 181). Originally, he says, the European kiss was a bite and a suction, the Mongolian being the act of smelling. The whites express to the person embraced that they would eat him or her with great pleasure; the yellows declare that the smell is that of an agreeable prey, either of nutrition or love. Whether from hunger or the sexual appetite, the two kinds of kissing have their origin, according to this author, in the instinct of the preservation of the race.

THE precommercial age, which was a very early stage in human culture, is exemplified at the present day, according to Letourneau (*Bull. Soc. d'Anthrop.*, 1897, viii. p. 152), by the Fuegans and Australians. The Eskimo, owing to contact with Redskins and Europeans, have, like the Veddahs of Ceylon, just passed beyond this stage. The Eskimo of Kamtchatka trade with the Russians, as do the Veddahs with the Cinghalese, by depôts, and avoid all direct communication.

THE lumbar curve of the vertebral column has been studied by Cunningham and by Turner, but very little information concerning this feature among the American races was forthcoming till a recent paper by Dr. G. A. Dorsey in the *Bulletin of the Essex Institute*, Salem, Mass. (vol. xxvii. p. 53). The mean index of eight varied American peoples ranges between 100·3 and 101·5; they are thus orthorachic. Dorsey considers the lumbar index as an important means of determining sex in any individual race or tribe, and that it bids fair to become one of the most valuable ethnic tests known in determining the physical superiority or inferiority of any tribe or race.

WE have received a letter from Mr. Saville-Kent with reference to the short article in NATURE of September 9 (p. 455) on the successful rearing of lobster larvæ by Mr. J. T. Cunningham. Mr. Saville-Kent points out that more than twenty years ago, in 1875, he was fortunate in rearing a number of these crustaceans from the egg to the final or ambulatory stage. A paper embodying the results of his experiments was communicated to the Conferences held in connection with the Great International Fisheries Exhibition in 1883, and it appears with accompanying illustrations in the official publications issued in connection with that Exhibition. We have referred Mr. Saville-Kent's letter, and the paper containing the results of his experiments, to Mr. Cunningham, who writes:—"I very much regret that in forwarding to you the facts concerning my experiments in lobster rearing at Falmouth, I overlooked Mr. Saville-Kent's previous success in the same practical problem. Although I had a vague recollection of having heard that he had made experiments of this kind, I had never seen any description of them, and I certainly did not think that he had succeeded in rearing the larvæ through the whole of their metamorphosis. Mr. Saville-Kent's paper, which I have now had the pleasure of seeing for the first time, was not in the library of the Plymouth Laboratory, at least I never saw it there, although I was fairly familiar with the contents of that library."

FROM the *Proceedings of the Chemical and Metallurgical Society of South Africa* for July last, it appears that, after many fruitless attempts, the treatment of stamp battery slimes from gold ores has now been mastered, and is steadily going on in several works in South Africa. Formerly the excessively finely crushed portion of the battery tailings, amounting to some 30 per cent. of the whole, was perforce allowed to run to waste, though theoretically worth nearly 1*l.* per ton. The slimes are now agglomerated and precipitated from the water in which they are suspended by the addition of lime water, and are then treated by agitation with very dilute solutions of cyanide (containing 0·01 per cent. or less of available KCy), and washed by settling and decantation, the gold being deposited by electrolytic action under the Siemens-Halske system. This process has been running for over twelve months at the Crown Reef Works, and is now costing about 3*s.* 9*d.* per ton, including royalty and management. The extraction is 83 per cent., and the net profit about 10*s.* per ton, or 50*l.* per day. The freshly-formed slimes in course of treatment at these works yield their gold to cyanide readily enough; but it is otherwise with accumulated slimes, in which oxidation of the pyrites has taken place. Here the presence of finely-divided ferrous sulphide and hydrate absolutely prevents the dissolution of the gold by withdrawing the free oxygen from the solution. Mr. W. Caldecott has discovered that by the supply of oxygen artificially this difficulty is cheaply and effectively overcome, and that jets of air, moreover, form the best means of agitation. Potassium permanganate is also used as an oxidiser. The oxidation and destruction of cyanide by air, long regarded as preventing its use for agitating cyanide solutions and promoting their solvent action, is not excessive in presence of ferrous sulphide, when the solution contains only from 0·005 to 0·008 per cent. of cyanide, or about 2 ounces per ton, an amount which, small as it is, is enough for the solution of the gold.

AN account of the range, cultivation, uses and products of the Camphor tree (*Cinnamomum camphora*) is given in a circular (No. 12) just distributed by the U.S. Department of Agriculture (Division of Botany). Notwithstanding the comparatively narrow limits of its natural environment, the camphor tree grows well in cultivation under widely different conditions. It has become abundantly naturalised in Madagascar. It flourishes at Buenos Ayres. It thrives in Egypt, in the Canary Islands, in south-eastern France, and in the San Joaquin Valley in California, where the summers are hot and dry. Large trees, at least two hundred years old, are growing in the temple courts at Tokyo, where they are subject to a winter of seventy to eighty nights of frost, with an occasional minimum temperature as low as 12° to 16° F. The conditions for really successful cultivation appear to be a minimum winter temperature not below 20° F., 50 inches or more of rain during the warm growing season, and an abundance of plant food, rich in nitrogen. In the native forests in Formosa, Fukien, and Japan camphor is distilled almost exclusively from the wood of the trunks, roots, and larger branches. The work is performed by hand labour, and the methods employed seem rather crude. The camphor trees are felled, and the trunk, larger limbs, and sometimes the roots, are cut into chips, which are placed in a wooden tub about 40 inches high and 20 inches in diameter at the base, tapering towards the top like an old-fashioned churn. The tub has a tight-fitting cover, which may be removed to put in the chips. A bamboo tube extends from near the top of the tub into the condenser. This consists of two wooden tubs of different sizes, the larger one right side up, kept about two-thirds full of water from a continuous stream which runs out of a hole in one side. The smaller one is inverted with its edges below the water, forming an air-tight chamber. This air chamber is kept cool by the water falling on the top and running down over the sides. The upper part of the air chamber is sometimes filled with clean rice straw, on which the camphor crystallises, while the oil drips down and collects on the surface of the water. In some cases the camphor and oil are allowed to collect together on the surface of the water, and are afterwards separated by filtration through rice straw or by pressure. About twelve hours are required for distilling a tubful by this method. Then the chips are removed and dried for use in the furnace, and a new charge is put in. At the same time the camphor and oil are removed from the condenser. By this method 20 to 40 pounds of chips are required for one pound of crude camphor.

DR. WILHELM HALBFASS contributes to *Petermann's Mittheilungen* the results of observations on eight of the Eifelmaare. Elaborate contour maps are given, and a series of records of temperature and transparency. All the lakes are practically circular, the bottom steepest near the edges. The Laachen See is by far the largest, while the Pulver-Maar is the deepest lake in Germany outside the Alps, attaining a depth of 74 metres.

A PHENOLOGICAL map of parts of the coast regions of Albania and Epirus, by Dr. A. Baldacci, of Bologna, appears in *Petermann's Mittheilungen* (vol. xliii. 7), with part of a paper by the same author describing the physical geography and climate of the district in relation to its flora. The special interest of the region lies in the transition from the Mediterranean to the Alpine-Arctic flora direct, without the necessary interposition of the usual coniferous belt.

DR. A. PHILIPPSON publishes in the *Verhandlungen der Gesellschaft für Erdkunde zu Berlin* a short account of a cruise amongst the Greek islands of the Ægean during 1896. A number of geological observations were made, and are plotted on a sketch map, forming a distinct contribution to our meagre knowledge of this interesting region. The distribution of the masses of crystalline rock and the arrangement of the lines of faulting, call for thorough exploration.

TWO important contributions to the literature of historical geography have recently been published in Germany. The *Zeitschrift der Gesellschaft für Erdkunde zu Berlin* (vol. xxxii. No. 2) contains a paper, by Dr. Konrad Kretschmer, on a Catalan map in the Biblioteca Estense at Modena of date 1375, with a reduced facsimile of the map appended. These Spanish maps are of the greatest interest to geographers, particularly on account of the commercial relations existing at that time between Italy and southern France and north-eastern Spain. Only fourteen have hitherto been known, and of these only three are accessible in facsimile: that here reproduced and elaborately discussed by Dr. Kretschmer forms the fifteenth, and is the first known Catalan circular map of the world. Nos. 5 and 6 of the present volume of the *Mittheilungen der k. k. Geographischen Gesellschaft* of Vienna contain an abstract of a Festschrift published in commemoration of the opening of the sea route to India by Vasco de Gama, being a translation of parts of the Mohît of the Turkish admiral, Seidî 'Ali, with reproductions of some of the maps. The translation is by Dr. Maxim Bittner, Privat-docent in Oriental languages in the University of Vienna, and there is an introduction by Prof. Tomaschek. The Mohît is practically a book of sailing directions compiled, by the best sailor Turkey ever had, about the year 1554. Two chapters and part of a third dealing with topographical matters were translated by Prof. Luigi Bonelli and published in 1894; and the present paper covers much the same ground, with improvements and additions derived from the one of the two existing manuscripts which is deposited in Vienna. Translations of other parts of the Mohît into English, by Joseph Baron von Hammer-Purgstall, were published in the *Journal of the Asiatic Society of Bengal* between the years 1834–38.

THE College of Agriculture at Tokyo is doing excellent experimental work, judging by the contents of the latest *Bulletins* it has issued. In that of June last are several interesting memoirs, amongst which we may mention "Contributions to the Chemistry of Saké Brewing," by J. Okumura, in which attention is directed to the loss of starch which takes place in the process of washing the rice before it is steamed for saké brewing, whilst some valuable observations are recorded on the enzyme of the *Koji* fungus (*Aspergillus oryzæ*). K. Yabe contributes a paper on the origin of the saké-yeast, in which he points out once more that the *Aspergillus oryzæ* is quite incapable of yielding the saké-yeast cells. K. Negami details the results of his experiments on the fermentation of a grape wine with the saké-yeast cells, which do not, however, encourage the use of the latter for this purpose, the taste of the fermented product being that of an average white wine, the *bouquet* being, moreover, of an inferior quality. A highly suggestive memoir, full of experimental observations, is contributed by U. Suzuki, entitled "On an important function of leaves." The author comes to the conclusion, as the result of his investigations, that reserve proteids in the leaves are decomposed into amido-compounds during the night, and the latter are transported from the leaves to the other parts of the plants. The leaves facilitate the formation of proteids in all parts of the plants by the assimilation of nitrates, yielding thereby amido-compounds. A great advantage is thus gained for the stems, roots and fruits, in which the conditions for nitrate assimilation are less favourable than in the leaves. The May *Bulletin* of the College is entirely devoted to a long memoir, by H. Tokishige, "On the nature of Japanese Farcy, an Enzootic Skin Disease of the Horses and Cattle of Japan."

INVESTIGATIONS carried out at the Purdue University Agricultural Experiment Station in 1895, demonstrated that an efficient preventive of potato scab (a parasitic disease) is obtained by treating the seed tubers with corrosive sublimate. The poisonous and corrosive nature of this compound renders the treatment objectionable to some extent, so investigations have been made with the idea of discovering a preventive having the good qualities of corrosive sublimate without its bad ones, and which could confidently be used as the standard fungicide for potato scab. According to a bulletin just received from the Agricultural Experiment Station referred to above, this substance is formalin, the germicidal action of which was discovered by Loew in 1888. Observations made at the station lead to the following conclusions:—Formalin, a non-poisonous, non-corrosive substance, will practically free seed potatoes from scab germs by an immersion for two hours in a solution of the approximate strength of 1 : 300. It is equal to corrosive sublimate in efficiency, and is without its dangerous and troublesome properties. Seed material of seemingly good quality, as well as that much affected with scab, shows beneficial results from treatment. The recipe for its use is to add eight fluid ounces (about one half-pint) of formalin to fifteen gallons of water, and soak the seed tubers in it for two hours before planting. This solution may be used several times.

A FOURTH edition of the skeleton guide to the Royal Gardens, Kew, is now on sale at the Gardens. It has been carefully revised so as to include all recent improvements, and the size has been somewhat reduced to make it more convenient for the pocket.

A BATCH of the *Bulletins of Miscellaneous Information* of the Royal Gardens, Kew, Nos. 122-129, just received, contains many articles of scientific and practical interest. Under the name *Rhizopus necans* sp.n., Mr. G. Massee describes and figures a parasitic fungus exceedingly destructive to lily bulbs in Japan. It appears, however, not to attack uninjured bulbs, but gains an entrance only through wounds, more especially through broken roots. Attention is called to the importance of the cultivation in India of the papaw-tree, *Càrica papaya*, from the value of the papain or "vegetable pepsin," which abounds in the unripe fruit. An interesting feature of the work done at Kew has been a compilation of the cryptogamic flora of the Gardens. Mr. G. Massee has been entrusted with the mycological department of the work, and now contributes a list of the fungi collected in the Gardens, numbering 337 genera and 1340 species, probably far surpassing in point of numbers, as well as in the variety of rare and interesting species, the mycological flora of any other area of equal size. The remarkable fact, however, is mentioned that not a single species of parasitic fungus that has proved destructive to plants, has been introduced to Europe through Kew. A list of the "Myxogastres" is also appended. From some notes contributed by the Director, it would appear that all questions respecting the botanical origin of myrrh are not yet settled, especially with regard to Somali myrrh; and travellers in that country are urged to bring home specimens of the tree from which it is obtained. At the instance of the Government of the Gold Coast, an investigation has been undertaken by Mr. W. H. F. Blandford of the insects destructive to cultivated plants in West Africa. The correspondence is now published which gives the results of this inquiry, and the suggested remedies. An interesting note is reprinted from the *Hawaiian Planter's Monthly*, by Mr. H. M. Whitney, regarding the grafting of the sugar-cane, and the possible production of a graft-hybrid. In the *Diagnoses Africanæ*, No. x., are contained descriptions of some of the novelties included in several important collections recently received at Kew: viz. that of Dr. Forsyth Major from Central Madagascar; that of Mr. G. L. Bates from the Cameroons region; and that of Mr. Alexander Whyte from North Nyasaland, a country which had never previously been explored botanically. Among other subjects referred to in these numbers are the West India sugar-trade, fruit-growing at the Cape, and the use of *Eucalyptus* timber for wood-paving.

THE periodical entitled the *Archives of Skiagraphy* has become the *Archives of the Rœntgen Ray*, edited by Dr. W. S. Hedley and Mr. Sydney Rowland, and published by the Rebman Publishing Company. It is chiefly as a pictorial record of applications of Röntgen photography to surgery that the periodical has found a professional public. This feature will be continued as heretofore, and, in addition, a certain amount of useful letterpress upon methods of work and progress of investigation will be included. The publication will thus not merely deal with the practical usefulness of the new radiation, but also with its scientific bearings. The number before us contains articles upon the nature of the Röntgen Rays, by Prof. S. P. Thompson, F.R.S.; Röntgen Rays, past and present, by Dr. W. S. Hedley; and a number of notes, mostly cuttings from the daily papers. All the subjects of the Röntgen photographs reproduced are of purely medical and surgical interest.

THE fourth edition of "Quantitative Chemical Analysis," by Prof. Frank Clowes and J. Bernard Coleman, has been published by Messrs. J. and A. Churchill. The book has not been modified to any considerable extent, but descriptions of a number of new methods and apparatus have been added.—Mr. Edward Stanford has issued a fourth revised edition of "Epping Forest," by Mr. Edward North Buxton. This excellent little book is not only an interesting guide to all the beauties of Epping Forest, but also a brightly-written handbook of local natural history. Chapters have been added on forest management, the geology of the district, pre-historic man and the ancient fauna, and the entomology, pond-life, and fungi of the forest. There are six large coloured maps, and many illustrations in the text.—A fourth edition of an illustrated handbook of instruction in methods of saving persons from drowning, has been published by the Life Saving Society. The book contains, in addition to a course of instruction in rescue from drowning, descriptions of the methods adopted in resuscitating the apparently drowned, and a short account of the principles underlying them.

THE following are among the papers and other publications which have come under our notice within the past few days:—An eulogy of the late Prof. Alfred M. Mayer, accompanied by a full-page portrait of the lamented investigator, is contributed to *Science* (August 20) by Prof. Le Conte Stevens.—An address on the connection between pharmacy and science, delivered by Prof. E. Shaer at the recent meeting of the German Apotheker-verein, appears in the *Pharmaceutical Journal* (September 18).—A paper containing the results of studies of Mexican and Central American plants, by Dr. J. N. Rose, has been published in the *Contributions* from the U.S. National Herbarium (vol. v. No. 3).—Dr. James Murie writes upon "Our Economic Sea Fishes," in the *Zoologist* (September 15), and describes a few of the results of the study of the life-history of our food-fishes during the past twenty years or so.—The eighth and ninth numbers of Dr. George King's "Materials for a Flora of the Malayan Peninsula," reprinted from the *Journal* of the Asiatic Society of Bengal, have just been distributed. In No. 9 the account of the Calycifloræ is begun. This contribution covers 345 pages, and Dr. King hopes "that one more contribution similar in size to the present one will suffice to complete the account of the Calycifloræ, and so to bring the whole series about half-way towards completion."—Vols. x., xi. and xii. of the *Annalen* of the Imperial University Observatory at Vienna, edited by Prof. Edmund Weiss, have been received. The contents include position observations of planets, comets and nebulæ, made with the various instruments at the Observatory from 1890 to 1893; observations with the meridian circle, zone observations with the 11¾-inch Clark's refractor, and meteorological observations.

THE additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius*, ♂) from South Africa, presented by the Earl of Orkney; a Coypu (*Myopotamus coypus*) from South America, presented by Mr. H. W. Garratt; an Arctic Fox (*Canis lagopus*) from the Arctic Regions, presented by Mr. G. B. Collier; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Mr. Harold Smith; a Water Vole (*Arvicola amphibius*) from Scotland, presented by Master E. Hope Vere; a Levaillant's Amazon (*Chrysotis levaillanti*) from Mexico, presented by Mr. Charles Strong; two Grey-breasted Parrakeets (*Myopsittacus monachus*) from the Argentina, presented by Mr. R. M. Copnall; two Gannets (*Sula bassana*) from Scotland, presented by the Hon. Walter Rothschild; a Marabou Stork (*Leptoptilus crumeniferus*) from

British Central Africa, presented by Captain C. F. Beeching; a Raven (*Corvus corax*) British, presented by the Rev. F. C. A. Barrett; a European Pond Tortoise (*Emys orbicularis*), European, presented by Miss W. Fenwick; a Common Marmoset (*Hapale jacchus*) from South-east Brazil, a Burchell's Zebra (*Equus burchelli*), born in the Menagerie, deposited; two Red Foxes (*Canis fulvus*) from Canada, a Black Woodpecker (*Picus martius*), a Hoopoe (*Upupa epops*), four Little Ringed Plovers (*Ægialitis curonica*), European, purchased.

OUR ASTRONOMICAL COLUMN.

THE CAUSE OF THE PROPER MOTIONS OF STARS.—When the parallax of the star 1830 Groombridge is considered in connection with the large proper motion of seven seconds of arc per annum, the conclusion is arrived at that the star is moving through space with a velocity which probably exceeds two hundred miles per second. In his "Popular Astronomy," Prof. Simon Newcomb briefly discussed the problem of stellar dynamics involved in this enormous velocity. He showed that if the universe be considered of such an extent that light would take 30,000 years to cross it, and if it contained one hundred million stars, having, on the average, a mass five times the mass of the sun, the gravitational attraction of a universe thus constituted would only be sufficient to give a velocity of twenty-five miles per second to a body drawn from infinity to the centre of the system of masses. The calculated limit is thus only about one-eighth the velocity deduced from the observed proper motion and parallax. Prof. Newcomb therefore concluded: "Either the bodies which compose our universe are vastly more massive and numerous than telescopic examination seems to indicate, or 1830 Groombridge is a runaway star, flying on a boundless course through infinite space with such momentum that the attraction of all the bodies of the universe can never stop it."

A new contribution to this inquiry was read recently before the American Philosophical Society by Mr. Luigi d'Auria. The object of the investigation was to determine whether, assuming the interstellar ether to possess the virtue of gravitational attraction, the force exerted by it would be sufficient to account for the proper motions of stars, and especially of the flying star 1830 Groombridge. In this paper it is shown that, "given the ether the density as estimated by Maxwell, and the power of attracting matter by gravity, a body placed within the sphere of ether containing all the stars of the visible universe, and at a distance from the centre of such sphere equal to that passed over by light in 2200 years, would pass this centre with a velocity equal to that of the star 1830 Groombridge, taking into account the attraction of the ether alone; and such body would oscillate about the same centre, rectilinearly, with a period of a little over *seven million* years, which would be also the period of oscillation of every other star." Mr. d'Auria recognises that some other, and unquestionable, cause may eventually prove to be responsible for stellar proper motions, nevertheless he thinks his results are worth putting on record.

NEW DETERMINATION OF THE SOLAR CONSTANT.—A fresh contribution to our knowledge respecting the sun's heat appears in the *Memorie della Società degli Spettroscopisti Italiani*, vol. xxvi., 1897, where Dr. G. B. Rizzo describes a series of observations for determining the solar constant, made at the station "Regina Margherita" on Monte Rosa. The apparatus used was a slight modification of Ångström and Chwolson's; the sun's rays being received on two brass discs attached to thermometers, which were alternately exposed and protected by two aluminium screens so arranged that when one disc was covered the other was exposed. To determine the quantity of solar heat absorbed per unit area per unit time, the formula of Chwolson was employed. Owing to the unsettled weather in September last, when the observations were made, the results were found at times to fluctuate considerably. In determining the solar constant or quantity of heat (measured in calories per minute) incident normally on a square centimetre at the earth's distance from the sun, it is necessary to assume some law for the effect of atmospheric absorption at the place of observation. Dr. Rizzo finds that the formulæ of Forbes and Crova for this purpose, when applied to his present observations, give for the solar constant the respective values 3·133 and 4·934. Both these values are somewhat in excess of the average of previous observations, but the divergence between them renders further investigation desirable.

THE DIAMETERS OF JUPITER AND HIS SATELLITES.—Herr Leo Brenner communicates to the *Astronomische Nachrichten* (No. 3444) the results of recent measures, made by him at the Manora Observatory, of the widths of the various bands and belts on Jupiter, and the angular diameters of the planet and its four large satellites. The following are the results of the measurements of diameters, reduced to mean distance:—

	Equatorial diameter.	Polar diameter.	Oblateness.
Jupiter	38″·539	36″·134	1 : 16·024
Satellite I.		1·060	
Satellite II. ...	1·063	0·958	1 : 10·123
Satellite III. ...	1·704	1·504	1 : 8·52
Satellite IV. ...	1·550	1·345	1 : 7·568

ACTION OF JUPITER AND SATURN UPON ENCKE'S COMET.—In a memoir which will shortly appear, M. A. Lebeuf gives formulæ for calculating secular inequalities when the mutual inclinations of orbits, and the eccentricity of the orbit of the disturbed body, are known. The formulæ are applied by M. Lebeuf, in the *Bulletin Astronomique*, to determine the secular inequalities of the elements of the orbit of Encke's comet in consequence of the action of Jupiter and Saturn. The values obtained are tabulated below:—

Elements of orbit.	Secular inequality due to Jupiter.	Secular inequality due to Saturn.	Simultaneous action of Jupiter and Saturn.
$\frac{de}{dt}$	+ 1″·38	+ 0″·2	+ 1″·40
$\frac{di}{dt}$	− 25·6	− 0·45	− 26·1
$\frac{d\Omega}{dt}$	− 35·9	− 0·85	− 36·8
$\frac{d\omega}{dt}$	+ 28·3	+ 0·66	+ 29·0
$\frac{d\epsilon}{dt}$	− 133·6	− 3·04	− 136·6

It is pointed out that the large eccentricity of Encke's comet, and the small distance of the comet from Jupiter, makes the use of the formulæ difficult in the case of Jupiter; but the results seem to justify their application to the case of Saturn.

PHASE-CHANGE OF LIGHT ON REFLECTION AT A SILVER SURFACE.

A LIGHT wave, when reflected[1] at the surface of separation of two media, may be altered in amplitude, or wave-length, or phase. Whilst, however, a change of amplitude or wave-length produces an obvious difference between the incident and reflected light, the existence and nature of a change of phase can only in general be inferred from the result of some kind of interference experiment. Thus the fact that a very thin transparent film is black when viewed by reflected light leads to the conclusion that a light wave is altered in phase by half a wave-length on reflection, either at a denser or at a rarer medium. Mechanical analogies suggest that the change probably takes place at the denser medium; and an experiment of Lloyd's, in which coloured fringes with a black centre were obtained by the interference of two beams of light, one directly transmitted, and the other reflected from a glass mirror, led to the same conclusion.

Jamin's experiments on metallic reflection showed that when light is reflected from a silver surface a phase-change is produced, and, moreover, that this change is different according as the light is polarised in, or perpendicular to, the plane of incidence. His experiments led to the determination of the

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[1] The term "reflection" is here used in its most general sense, to include such phenomena as phosphorescence, &c.